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安徽潜山古新世狉兽科新材料及系统发育

胡耀明
（中国科学院古脊椎动物与古人类研究所）

关键词 安徽潜山 古新世 狉兽科 系统发育

内 容 提 要

本文记述了发现于潜山盆地中古新统望虎墩组上段的两件保存较好的狉兽类化石，它们分别代表了两个新属种：古井曙狉(新属、新种)（*Eosigale gujingensis* gen. et sp. nov.）和余氏棋盘兽(新属、新种)（*Qipania yui* gen. et sp. nov.)。在分析狉兽科各属及相关类群特征的基础上，重新厘订了狉兽科的涵义，探讨了狉兽类与亚洲其他古老真兽类之间的系统发育关系，认为狉兽科和假古猬科的关系最近。

狉兽类是亚洲土著古老真兽类的重要成员，有较广的地史地理分布。自 Simpson (1931) 记述了产自内蒙古的第一个单型属 *Anagale* 后，有很多属种被归入狉兽科中(表1)。1990—1992年，中国科学院古脊椎动物与古人类研究所野外队在安徽省潜山县古井乡和桃铺乡中古新世地层中发现两件保存较好的狉兽类标本。本文将对其进行详细描述与比较，并对一些与之有关的问题加以讨论。

本文系笔者硕士论文的一部分，在写作过程中得到导师李传夔先生的悉心指导；在野外工作期间，得到安徽省潜山县文物管理所余本爱所长及全体同志的热情帮助；谢树华、王元青、郭建崴、张立波及李丁生等同志参加了野外工作；王元青同志还对标本研究提出了宝贵意见；谢树华同志耐心指导并代为修理部分标本；朱敏博士提供 Hennig 86 软件；张杰同志摄制图版；李荣山同志绘制图件；童永生、郑家坚、黄学诗先生等审阅了论文初稿，美国纽约自然历史博物馆 M. C. McKenna 博士也与笔者讨论有关问题并修改英文稿，在此一并致谢。

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系 统 描 述

狉目 Anagalida Szalay & McKenna, 1971

狉兽科 Anagalidae Simpson, 1931 em.

曙狉属(新属) *Eosigale* gen. nov.

属型种 古井曙狉(新属、新种) *Eosigale gujingensis* gen.et sp. nov.

表 1 猥兽科一览表

Table 1 The general survey of Anagalidae

属种名称 (Genus and Species)	地点和层位 (Locality and Horizon)	文献 (Reference)
Anagale gobiensis	Ulan Gochu Form. E. Oli.; Towin Oboes, Nei Mongol	Simpson G. G., 1931 McKenna M. C., 1963
Anagalopsis kansuensis	?Oli.; Hui-hui-pu, Gansu	Bohlin B., 1951
# *Anaptogale wanghoensis*	Wanghudung Form., E.-M. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
* *Chianshania jianghuiensis*	Wanghudung Form., E.-M. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
# *Diacronus wanghuensis*	Upper Mem., Wanghudung Form., M. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
Hsiuannania maguensis	Shuantasi Group, L. Pal.;Xuancheng, Anhui	Xu Q. -Q., 1976
H. minor	Chijiang Form., L. Pal.; Chijiang, Jiangxi	Ding S. -Y. & Zhang Y. -P., 1979
H. tabiensis	Doumu Form., L. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
H. sp.	Doumu Form., L. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
Huaiyangale chianshanensis	Upper Mem., Wanghudung Form., M. Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
cf. *Huaiyangale leura*	Nongshan Form., L. Pal.; Nanxiong, Guangdong	Ding S. -Y. & Tong Y. -S., 1979
H. sp.	Upper Mem., Wanghudung Form., M.Pal.; Qianshan, Anhui	Xu Q. -Q., 1976
* *Khashanagale zofiae*	L. Pal.; Gashato, Mongolia	Szaly F. S.
* *K.* sp.	L. Pal.; Gashato, Mongolia	& M. C. McKenna, 1971
Linnania lofoensis	Shanghu Form., M. Pal.; Nanxiong, Guangdong	Chow M. -Z. *et al.*, 1977
L. qinglingensis	Fanggou Form., E-M. Pal.; Luonan,Shaanxi	Xue X. -X., 1986
# *Stenanagale xiangensis*	Zaoshi Form., E. -M. Pal.; Chaling,Hunan	Wang B. -Y., 1975
* *Wanogale hedongensis*	Lower Mem., Wanghudung Form., E. -M. Pal.; Qianshan, Anhui	Xu Q. -Q. 1976
Eosigale gujingensis	Upper Mem., Wanghudung Form., M. Pal.; Qianshan, Anhui	this paper
Qipania yui	Upper Mem.,Wanghudung Form., M. Pal.; Qianshan, Anhui	this paper

注：所有曾被归入猥兽科的属均列于此表。本文将带"*"号者排斥在猥兽科之外，将带"#"者作为猥兽科的可疑分子 (Szalay & Li (1986) 已将 *Diacronus anhuiensis* 归入灵长目)。

E.: Early; M.: Middle; L.: Late; Pal.: Paleocene;Oli.: Oligocene;Mem.: Member; Form.: Formation

特征 个体大小如 *Linnania*，头骨低窄；单泪孔，无泪结节；眶后突弱，眶下管短，眶前窝小而浅；下颌骨水平支纤细，上升支薄而高。

齿式为 3?. 1.4.3/3.1.4.3。P1/1 单根，P4/无后尖，P/4 跟座单尖状；上臼齿横宽，前后齿带细长，齿冠高度小于宽度，齿冠低平；M/1、M/2 下次尖比下原尖大，跟座比齿座宽，跟盆浅宽；M/3 下内尖消失；臼齿釉质层极薄，不入齿槽，单面高冠程度较弱。

属名由来 *eos-*，来自拉丁文，初始、黎明之意；*-gale* 来自 *Anagale*，犭丙兽。属名寓早期、原始之意。

古井曙犭丙（新属、新种）*Eosigale gujingensis* gen. et sp. nov.

（图 1—4；图版 I,1）

正型标本 前部较完整的头骨及同一个体的一对下颌骨，中国科学院古脊椎动物与古人类研究所标本编号： V7425。

地点及层位 安徽省潜山县古井乡傅老屋，中古新统望虎墩组上段。

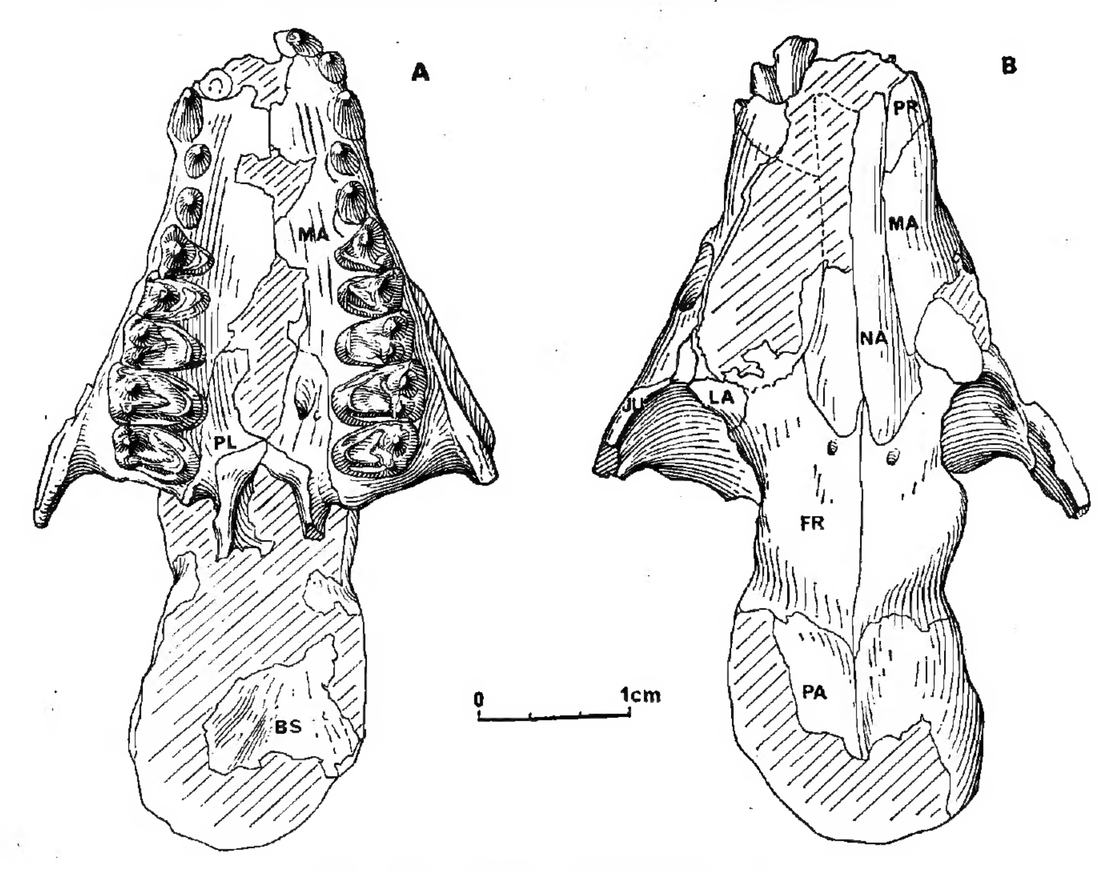


图 1 古井曙犭丙（新属、新种）（V7425）头骨

Fig. 1 The skull of *Eosigale gujingensis* gen. et sp. nov. (V7425)

A. 腹视 (ventral view), B. 背视 (dorsal view)

BS: Basisphenoid 基蝶骨; FR: Frontal 额骨; JU: Jugal 颧骨; LA: Lacrimal 泪骨; MA: Maxilla 上颌骨; NA: Nasal 鼻骨; PR: Premaxilla 前颌骨; PA: Parietal 顶骨; PL: Palatine 腭骨

特征 同属。

种名由来 以化石产地古井乡命名。

描述比较 标本因受挤压而变形,头骨中矢面稍向右倾。

头骨:眼眶之前保存较好,后部(包括眼眶大部)仅可见其轮廓。头骨较低,吻部较短;自吻区向后,颜面向外扩展较快,而使面区后部平宽。眼眶较大,眶内宽阔,面向侧方;颞区未保存,从眼眶大小和脑颅轮廓、大小看,颞窝与眼眶大小相近,两者之间界线模糊。脑颅窄小;听区、枕区均未保存。

1. 鼻骨 右侧鼻骨保存较好。鼻骨细长,中段收缩(最窄处约 2.3mm,在 P2/上方),向前稍扩展,前端破损,向后明显变宽(最宽处在 M1/上方,约 3.7mm);左右鼻骨后端不并合,相距 2.4mm,不与泪骨相接。

Eosigale 的鼻骨与 *Anagale* 及 *Anagalopsis* 的相似,但 *Eosigale* 左右鼻骨后端不并合,且在眼眶前缘之后,而 *Anagale* 则在眼眶之前(*Anagalopsis* 的鼻骨可能也达到眼眶前缘后方),*Eosigale* 和 *Anagalopsis* 的鼻骨比 *Anagale* 的显得细长。

2. 前颌骨 前颌骨只部分保存。鼻突发育,尖端位于 P1/齿根上方;腭突保存不好。门齿孔未保存,估计不大。

狉兽科中,*Anagale* 的前颌骨有部分保存,鼻突短,末端在犬齿齿根之上。

3. 上颌骨 面突占据了颜面区的绝大部分,与额骨的接缝较长,约 4.5mm。眶前窝浅,中等大小。眶下孔近圆形,中等大小,位于 P3/-P4/上方。眶下管短,长 6mm;其后口(上颌孔)扁圆形,上壁极薄,紧贴上方的泪骨,在眶内对准M1/与M2/的间隙位置。腭突占硬腭的大部分,表面有一浅的腭沟,向前变平消失,向后越过骨缝连到腭管口。眶突较宽,但不构成眼眶内壁。眶突前外角是上颌孔。颧突从后外角斜向后方伸展,伸展方向与中矢面交角约 30 度,外面被颧骨前端覆盖。

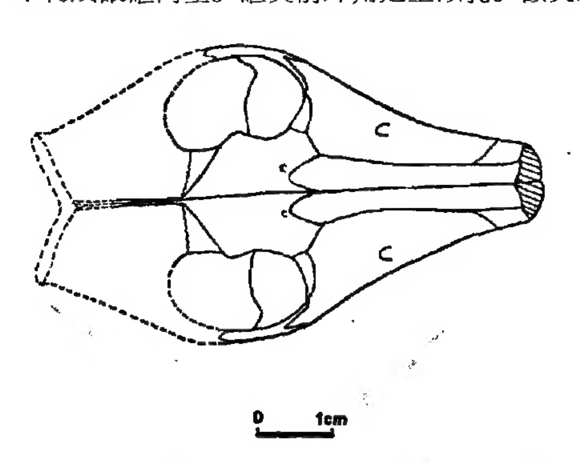


图 2 古井曙狉(新属、新种)头骨复原(背视,后半部参考 *Anagale* 的头骨素描图)

Fig. 2 The reconstruction of the skull of *Eosigale gujingensis* gen. et sp. nov. in dorsal view with the posterior half refering to the skull of *Anagale gobiensis*

同 *Anagale* 及 *Anagalopsis* 一样,*Eosigale* 的上颌骨面突占了颜面大部分,且与额骨相接,腭突很发育,眶突不与额骨相接,但 *Eosigale* 的眶下管比 *Anagale* 及 *Anagalopsis* 的更为短粗,眶前窝相对浅小。

4. 泪骨 泪骨结构简单。面突小,为三角形,外端较尖,与颧骨相接(已破损);后缘前凹,构成眼眶前缘,没有泪结节。眶突也为三角形,构成眼眶前壁,在外角处有一圆形泪孔,虽边缘已破,仍可肯定该泪孔中等大小,主体部分在眶内;眶突下缘盖在上颌孔上壁上。内缘已有破损,但从旁边的碎片看,泪骨下接腭骨应无问题;眶突在靠近上边缘处有一凹槽,槽内有若干小坑(孔?),在 *Anagalopsis* 的标本上也有类似的构造。

泪骨面突小，不与鼻骨相接，眶突大，与腭骨相接，这是 *Eosigale* 与 *Anagale* 的共同点，不同的是 *Eosigale* 只有一个泪孔，主体在眶内，无显著的泪结节(这也是 *Anagalopsis* 的特点)； *Anagalopsis* 的眶内部分保存不好，Bohlin(1951) 的图片似暗示泪骨与腭骨不接触。

5. 腭骨 腭骨保存不好，在硬腭面上呈舌状，前端伸至P4/-M1/。左腭骨的腭板上有一腭管开口，向前连接腭沟，另有若干小孔；腭骨后缘无大的后腭管(postpalatine canal)，只在靠近上颌骨后内角处有一切迹供脉管及神经经过；腭板后缘的腭后隆起(postpalatine torus) 明显；后缘正对 M3/，向两侧延伸为腭骨垂直板的腹缘，并在外侧有一小孔，该孔也许起腭后管的部分作用。腭骨构成眼眶内壁，但不伸达眶底；在靠近腭骨与上颌骨眶突接缝的腭骨一侧沿缝有一浅窝，底部有一个小孔，可能是背腭孔；上部有一侧扁孔为蝶腭孔，位置正对 M3/。腭骨前端破损，邻近的上颌骨边缘平直，不可能伸过去，因此只能是上方的泪骨下伸或腭骨上延到此处，这样上颌骨和额骨不大可能在此接触。

Anagalopsis 的腭骨未保存。*Anagale* 的原描述者对腭骨着墨不多，但从图版看，硬腭部分与 *Eosigale* 接近，唯腭后棘更尖，并且在 M3/后方。

6. 额骨 额骨低平，无明显的眶后突，眶上脊低圆，向后延伸为颞上脊。左右颞上脊向背侧汇合于额骨与顶骨接合处。额骨前部正对鼻骨后端有一额孔。额骨向眼眶内壁下垂部分已破碎；额骨在其与顶骨接缝稍前方有所收缩(此收缩与嗅球和大脑半球分界处相对应，这样额骨基本上未覆盖在大脑半球上)；也就是在这个收缩处，额骨下延很深，边缘

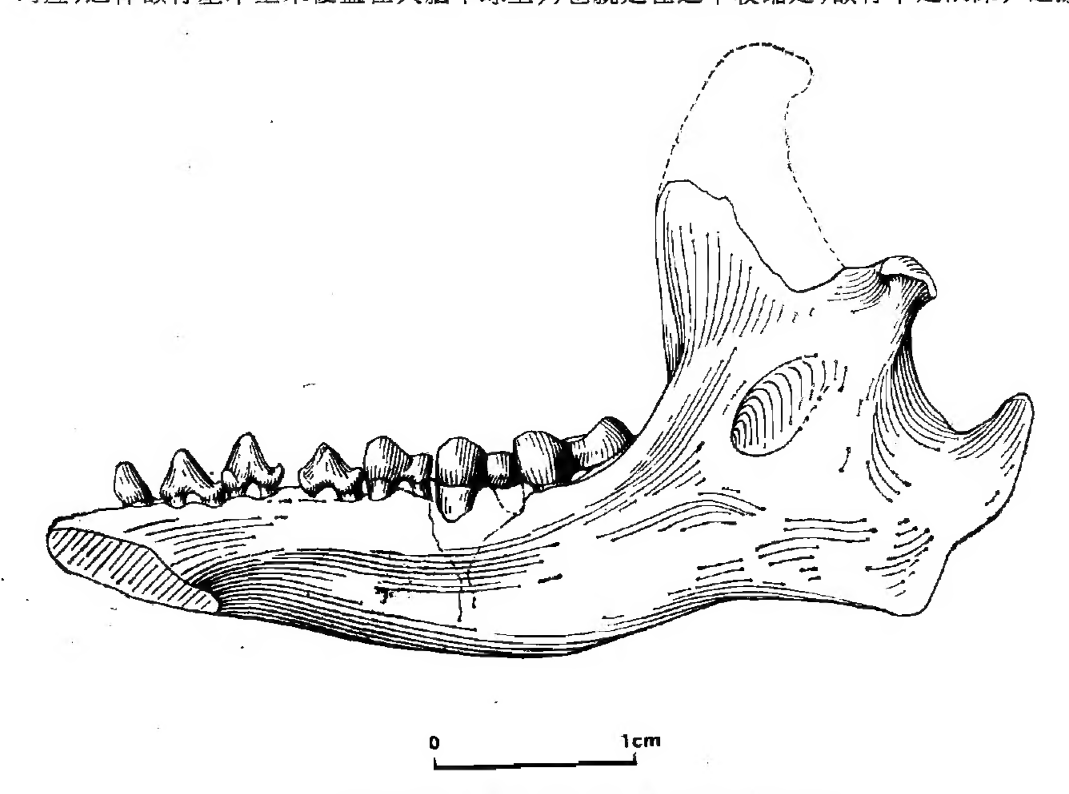


图 3 古井曙猴(新属、新种) (V7425) 右下颌骨(舌侧视)
Fig. 3 Internal view of the right mandible of *Eosigale gujingensis* gen. et sp. nov. (V7425)

破损,无法判断是否和鳞骨接触。

Eosigale 的额骨和 *Anagale*、*Anagalopsis* 的差别较大。后二者额骨均比 *Eosigale* 的短宽,有显著的眶后突,而且 *Anagalopsis* 有眶上孔。

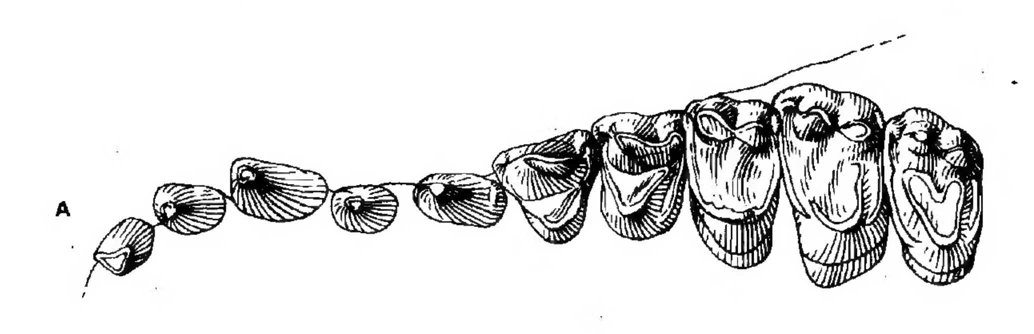
7. 顶骨 仅右侧保存稍好。左右顶骨在中央愈合成矢状脊，顶外脊不明显。顶骨向下包卷,包容了脑颅侧面的大部分,下缘可见与鳞骨相接的痕迹,即鳞状缝的位置。

Eosigale 的顶骨与 *Anagale* 的不同,后者左右顶外脊明显,并在后端并合到人字脊中央,而且顶骨外面鼓圆,似显示 *Anagale* 的大脑要比 *Eosigale* 的发达。

此外,腭骨眶突后下方有一小骨片紧贴眶突,可能是眶蝶骨碎片。眶窝和颞窝交界处额骨下方可能是翼蝶骨碎片。脑颅腹面有一梯形骨片,估计是基蝶骨,其后缘平直，似应为其与基枕骨的接缝。左右颧骨均仅保存前端一段,上下分叉,中等粗壮。

下颌骨：左右下颌骨均有破损。联合部从前端延到 P/3 之下。骨体下缘弯曲,最深处在 M/2 之下,并在咬肌窝下方凹入。外侧光滑微凸,颏孔至少三个,最后一孔最大，在 P/4 后根下方,最前一孔在 P/1 下方。内侧微凹，下颌孔位于齿列线后方，距 M/3 约 7mm。齿槽缘较平直。下颌角成钩状,尖端高于齿列线，指向后上方。冠状突薄而宽扁,成钩状,尖端后指,其前缘陡直。关节突在下颌角和冠状突正中间位置,比齿列线高得多,关节面稍显横宽,前后向凸出成柱面状。咬肌窝较宽,内凹,前缘咬肌脊显著。

同 *Anagale*、*Anagalopsis* 相比，*Eosigale* 的下颌骨稍显细弱，上升支陡直，高而



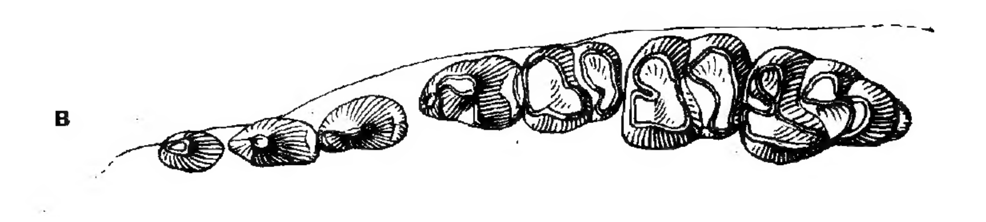


图 4 古井曙𪕊(新属、新种) (V7425) 齿列冠视图

Fig. 4 The crown view of the dentition of *Eosigale gujingensis* gen. et sp. nov. (V7425) A. 左 I2/-M3/ (left I2/-M3/); B. 右/P1-/M3 (right P/1-M/3)

薄。*Anagale* 只有两个颏孔，角突位置比 *Eosigale* 低，而下颌孔、关节突位置比 *Eosigale* 高；*Anagalopsis* 下颌支更粗壮，骨体下缘更为弯曲，上升支前缘更平坦，关节突更高，只有一个颏孔，犬齿下方有一鼓包用于容纳特化的犬齿根。

归纳起来，*Eosigale* 的头骨有以下特征：

01）吻部长度中等；
02）眼眶大，开放，颞窝比眼窝大；
03）头骨低平，脑颅可能比较小；
04）前颌骨中等大小，鼻突后端在 P1/上方，不与额骨相接；
05）鼻骨纤细，长度中等；
06）门齿孔小到中等；
07）上颌骨面突与额骨接缝中等长度；
08）上颌骨面突远大于前颌骨和鼻骨；
09）额骨前端分叉；
10）眶下管长度及大小中等；
11）眶前窝浅而小；
12）上颌骨腭突比前颌骨腭突大得多；
13）上颌骨眶突部分仅作为眶底，不构成内壁；
14）无后腭管；
15）硬腭后缘在左右 M3/之间；
16）腭后隆起低；
17）蝶腭孔和背腭孔在一个窝内；
18）泪骨面突小，不和鼻骨相接；
19）腭骨眶突和泪骨相接；
20）单个泪孔，主体在眼眶内，无泪结节；
21）额骨上有额孔；
22）额骨无明显眶后突，无眶上孔；
23）眶上脊、颞上脊和矢状脊低；
24）颞上脊在额骨上；
25）下颌关节位置低。

因材料所限，本文只能列出 *Eosigale* 头骨前部的特征，但不难看出，它是迄今最原始的砸兽类。

牙齿：I1/未保存，估计和 I2/、I3/结构相近。I2/齿冠锥形，微前倾；舌侧有两个小磨蚀面，主要磨蚀面在后方。I3/已破损，估计与 I2/大小接近，形态相似。

上犬齿单根，齿冠锥形，直立，高度为相邻 P1—2/的两倍，但并未特别增大，齿冠表面光滑。

P1/单根，锥形，高度小，内外壁光滑、直立，前后坡陡，隐约见刃状脊。P2/双根，高度接近 P1/，形似 P1/而更扁长，前后坡脚有小突起。P3—4/三根。P3/齿冠近于正三角形；外侧仅一个主尖，外壁光滑，内壁微凸，前后坡刃状脊明显，延向小而尖的前后附尖；原尖锥形，微向唇侧包卷，比外侧主尖低，U 形脊不发达；无前齿带，从后附尖向原尖后侧伸出一极微弱的后齿带。P4/的齿冠结构与 P3/相似，但原尖钝锥形，齿冠成横宽的亚方形，整体上显得比 P3/粗壮，U 形脊、后齿带也更明显。P3—4/的主要磨蚀面在原尖和外侧主尖的后壁，后齿带的上方。

上臼齿近方形，横宽，高度稍小于长度，明显小于宽度，釉质层很不发育，仅见于齿冠上部。M2/最大，冠面已有磨蚀，外侧前后尖发育，呈小的钝锥形，向舌侧包卷，无明显连脊；前后附尖很小；原尖高大，柱形，向唇侧包卷，U 形脊前、后臂分别伸向前后尖内侧；未见前后小尖；前后齿带发育，窄但位置很高，仅稍低于 U 形脊；M3/后尖退化，无后附尖。上臼齿前后齿带之上部分趋于磨平，连成一个磨蚀面。

上齿列自P3/向前排列稀疏，有短的齿隙；P4/-M3/排列紧密。

右侧下颌骨保存较好，具 P/1-M/3 和 I/1-C 的齿根。

从齿根看，下门齿向前伸出，极平坦，排列紧密，其中 I/2 和 I/3 大小相近，未退化。I/1 很小，趋于退化。下犬齿比前后相邻齿大，但未特化。

P/1 单根，扁锥状，微前倾。P/2 双根，扁锥形，内外壁光滑直立，前坡刃状脊清楚，后坡陡直，坡脚有小的跟突。P/3 基本形态似P/2，但前坡脚有下前尖雏形，跟突也更明显，整体上比 P/2 粗壮。P/4 长方形，齿冠在 P/3 的基础上分出了下后尖，下前尖在下原

尖前方,低而显著,呈刃状;下后尖比下原尖小,基部相连,两者后壁构成一个整体,延向后突起,无明显跟盆。

表 2 上颊齿测量数据(单位: 毫米)

Table 2 The measurements of upper cheek teeth (in mm)

	P4/		M1/		M2/		M3/	
	长 L	宽 W	长 L	宽 W	长 L	宽 W	长 L	宽 W
Eosigale gujingensis	3.0	4.0	3.1	4.5	3.5	4.9	3.2	4.1
Qipania yui	3.5	4.5	3.2	5.1	4.3	5.7	3.5	5.1
Huaiyangale chianshanensis			3.7	5.2	3.7	5.3	3.1	5.0
Hsiuannania tabiensis	3.3	3.5	4.5	4.1	5.0	4.5	4.1	4.0

注: *Huaiyangale chianshanensis* 和 *Hsiuannania tabiensis* 的数据引自徐钦琦(1976)。

表 3 下颊齿测量数据(单位: 毫米)

Table 3 The measurements of lower cheek teeth (in mm)

	P/4		M/1		M/2		M/3	
	长 L	宽 W	长 L	宽 W	长 L	宽 W	长 L	宽 W
Eosigale gujingensis	3.1	2.2	3.4	2.8	3.6	3.6	4.0	3.7
				2.9		3.8		3.0
Qipania yui	4.1	3.0	4.4	4.0	4.5	5.7	5.3	4.2
		3.2		3.5		4.5		3.5
Huaiyangale chianshanensis	3.0	1.6	3.1	2.6	4.0	3.0	4.5	3.0
		1.4		2.3		3.0		2.5
Hsiuannania maguensis	3.6	3.4	4.2	3.8	4.2	3.5	4.9	3.8
		2.7		3.6		3.4		3.1
Anagalopsis kansuensis	3.7	3.8	4.2	4.3	4.7	4.5	6.2	4.2
		3.3						
Anagale gobiensis	3.3	2.4	3.6	3.1	3.6	3.2	3.7	2.6
		2.3		2.9		3.0		2.1

注: 1) 表中上行为三角座宽,下行为跟座宽。
2) *Huaiyangale chianshanensis*, *Hsiuannania tabiensis*, *Anagalopsis kansuensis*, 和 *Anagale gobiensis* 的数据引自徐钦琦(1976)。

下臼齿排列紧密,外壁双柱形,内壁平直,单面高冠明显,釉质不进入齿槽。冠面已遭磨蚀。M/1—2 结构相似,近于方形,M/2 比 M/1 大,齿座前后压扁,无下前尖,只有钝锥形下原尖和下后尖,两尖各占半个齿座,后缘有脊相连,后尖比原尖大。跟座长度与齿座接近,但比齿座宽,下次尖钝锥形,比下原尖大;下内尖也为钝锥形,下次小尖小,下斜脊短,伸到齿座后壁中央,跟盆小而浅。M/3 齿座宽度与 M/2 接近,齿座结构与 M/1—2

相似；跟座比齿座窄，因下次小尖的增大使跟座更显窄长；下次尖发育，钝锥形，不如下原尖大，斜脊和下内尖退化，跟盆浅。下臼齿齿座和跟座高差不明显，磨蚀后相邻齿的跟座和齿座相接共同构成一个机能单元接纳相应上臼齿的原尖。

Eosigale 的齿列无疑是狉兽型的，门齿 3/3，与狉兽科中已知唯一保存门齿的 *Anagale gobiensis* 相似；犬齿未特化，也与 *Anagale* 相似，而与 *Anagalopsis* 迥异；P3—4/没有后尖，P/4 下前尖极小，跟座为单尖状，这与所有其它狉兽不同；P/3 与 *Anagalopsis* 的一样未臼齿化；臼齿与 *Huaiyangale* 相似，但 *Eosigale* 上臼齿横宽低平，齿带窄长，下臼齿跟盆极浅，下原尖、下后尖及跟座各尖呈钝锥形，釉质层极薄，单面高冠程度比其它狉兽弱。颊齿测量数据见表 2、表 3。

棋盘兽属（新属） *Qipania* gen. nov.

属型种　余氏棋盘兽（新属、新种） *Qipania yui* gen. et sp. nov.

特征　齿式为 2.1.4.3/2.1.4.3。门齿很小，上门齿直立，下门齿前倾，上下犬齿增大。P1/1 退化，P1/双根，P/1 单根，P4/比 *Anagalopsis* 更侧扁而与 *Hsiuannania* 相近；上臼齿横宽，齿带细长，有小的前小尖，内侧釉质层刚好进入齿槽。P/4 保留有小的下前尖；M/1—2 跟座比齿座窄、短；下臼齿两侧釉质均进入齿槽。咬合时下门齿可能包在上门齿外面。

属名由来　因属型种产地得名。

余氏棋盘兽（新属、新种） *Qipania yui* gen. et sp. nov.

（图 5、6；图版 I，2）

正型标本　一成年个体的一对下颌骨及破碎上颌骨，保存了绝大部分牙齿（V7426）。

产地和层位　安徽潜山县桃铺乡棋盘村附近公路边，中古新统望虎墩组上段顶部。

特征　同属。

种名由来　种名赠给潜山县文物管理所余本爱所长，以感谢他多年来的大力支持。

描述比较　从齿列看，*Qipania* 大小接近 *Hsiuannania*，比 *Anagalopsis*、*Huaiyangale* 等要大。

上门齿已经散落，左 I2/和右 I3/保存完好，左 I3/齿冠大部保存。上门齿基本形态相似，都为单锥状，齿根尖长，齿冠侧扁；I2/稍小，主要磨蚀面在前壁，在与对侧 I2/相邻的冠面上也有蚀痕；I3/稍大，磨蚀面在齿冠前壁，其余部分釉质层完好。

上犬齿粗壮，成牛角状，单根，齿冠尖。前壁拱，后壁直。

P1/与 P2/及 P2/与 P3/之间齿隙明显。P1/很小，趋于退化，双根，扁锥形，前后坡刃不明显。P2/双根，明显大于 P1/，也为扁锥形，但后坡刃状脊明显，前、后附尖小而清晰。P3/三根，内根前移到前根前内方，使整个齿冠成歪三角形，冠面有三个主尖：前尖最大，呈扁锥形，其前坡陡，有刃状脊，后坡缓，有脊连到后尖；后尖明显小于前尖，亦为扁锥形；原尖锥形，小于前尖，内壁浑圆，U 形脊不发育，与前、后尖以浅沟相隔。无小尖、附尖，后齿带细长，高位，从原尖后方一直伸到后尖后方。P4/比 P3/大，更为臼齿化，齿冠更高；内齿根大，但位置不如 P3/的内根那样靠前；齿冠仍为歪三角形，单面高冠明显，主

尖的形态、相对大小及位置关系与 P3/相似，但 P4/在前尖前内侧有前小尖，前尖前方有低的前附尖，U形脊伸向前小尖和后尖内侧，后齿带短宽，在齿冠后壁中部。

上臼齿呈柱状，排列紧密，单面高冠显著，内侧釉质刚好进入齿槽，外侧齿根退化，齿冠主要由内侧齿根支持。M1—2/宽大于长，呈亚方形，M2/比 M1/大，两者结构相似：前后尖紧靠唇缘，呈钝锥形，挤得较紧，后尖稍小于前尖，但两者都远小于原尖；原尖高大，呈柱状，内壁浑圆；唇侧有前后附尖，前附尖大小如后尖，前小尖锥形，位于前尖前内侧，无后小尖；U形脊伸到前小尖和后尖内侧，前后齿带位置很高，因挤压更显细长。M3/稍退化，比M1/还小，基本构造似 M1—2/，但后尖退化，后齿带短宽，形态趋于圆形。

下门齿向前伸出，其中 I/2 伸展方向与齿列线的夹角仅有 30 度左右，I/3 伸展方向与 I/2 接近，唯更外撇；I/2 锥状，齿槽接近下颌联合面，齿根很长，齿冠顶端蚀平，主要磨蚀面在齿冠后壁(舌侧)；I/3 形似 I/2，齿冠顶部也蚀平，主要磨蚀面也在后侧（但不是舌侧，而偏向唇侧)。从磨蚀面的位置来看，I2/与 I/2、I3/与 I/3 分别对咬，下门齿包在上门齿外侧，而不象常见的那样上门齿盖压在下门齿外侧。这种"包牙式"的咬合方式究竟是个体病态还是类群特征目前很难断定。

下犬齿稍前倾，并向外撇，形态与上犬齿相似，但稍小。

P/1—2 较小，P/3—4 明显增大。P/1 与 P/2 之间齿隙显著。P/1 单根，齿冠扁锥形，前坡缓，有刃状脊，后坡较陡。P/2 比 P/1 大许多，双根，只有一个主尖，前基部有小的下前尖，后基部有小的跟突。P/3已初步臼齿化，可区分出齿座和跟座，齿座上三个主尖清晰可辨。下原尖锥形，高大；下后尖在下原尖内后方，明显小于下原尖；下前尖在下原尖前内角处，很小。三主尖之间各以浅沟相隔。下跟座极小，长度仅为齿座三分之一左右，宽度与之相近，跟座高度仅有齿座的一半左右，已经蚀平。P/4 臼齿化程度较高，趋于方形

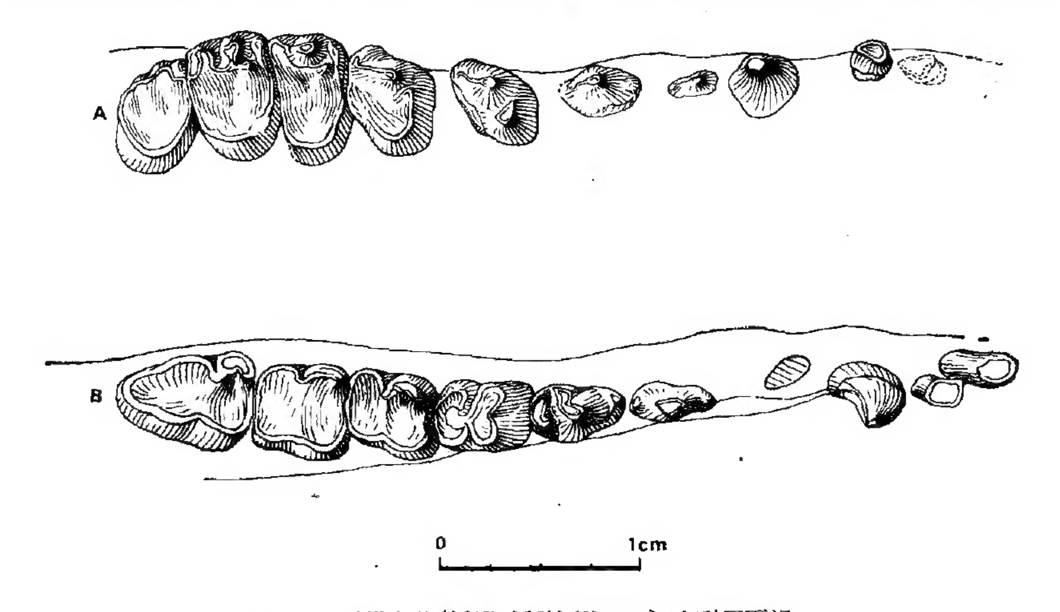


图 5 余氏棋盘兽(新属、新种)(V7426) 齿列冠面视
Fig. 5 The crown view of the dentition of *Qipania yui* gen. et sp. nov. (V7426)
A. 右侧 I2/-M3/ (I2/依左侧复原)(right I2/-M3/); B. 右侧I/2-M/3 (right I/2-M/3)

下后尖比下原尖高大，下前尖很小；跟座长度超过齿座长度的一半，虽已蚀平，但仍可辨认锥形的下次尖、下次小尖和下内尖，跟盆深，在下内尖前方的开口较宽；跟座高度为齿座的一半左右；磨蚀后，跟座和 M/1 的齿座前半部共同构成一个机能单元用于接纳 P4/的原尖，其齿座的磨蚀面在下原尖和下后尖后壁，可能是与 P4/ U 形脊前臂磨剪而成。

下臼齿排列紧密，冠面纹饰已蚀去，M/1—2 呈方形。M/1 齿座扁宽，前缘平直，无下前尖，从蚀痕看，下后尖和下原尖分处齿座内外缘，下后尖可能更大些，跟座比齿座窄短，无法从蚀痕判断跟座纹饰发育情况，后边缘平直，估计下次小尖退化，内外缘下内尖和下次尖则较发育，跟盆开口极窄，估计跟盆深窄封闭。M/2 比 M/1 大，是下齿列中最大者，其冠面蚀痕与 M/1 基本一致。M/3 宽度介于 M/1 与 M/2 之间，齿座的构造与 M/1—2 无异，跟座因下次小尖的增大而额外加长，呈梯形，内尖前方跟盆开口仍很小，估计跟盆仍为深窄、封闭的形态。磨蚀后，下臼齿的齿座和跟座高度相近，并且相邻齿的齿座(后齿）和跟座(前齿)共成一个机能单元接纳相应上臼齿的原尖（M/3 的跟座自成一体，M/1 的齿座与 P/4 的跟座结合接纳 P4/ 的原尖)。下臼齿(及 P/4）成棱柱状，单面高冠强烈，内外釉质均进入齿槽。

Qipania 的门齿数为 I2/2，与𤟤兽类中保存门齿的另两属 *Eosigale* 和 *Anagale*(门齿数目为 3/3）不同，咬合方式也不一样。

Qipania 犬齿比相邻齿明显粗壮。从相对大小看，*Qipania* 的犬齿要比 *Eosigale*、*Anagale* 的更为粗壮，但还没有 *Anagalopsis* 的犬齿那样发达。

在𤟤兽科中，*Qipania* 的前臼齿从前到后大小分化最显著，其 P1/1 特别小，呈退化趋势；P2/不象 *Anagale* 那样有锥形原尖，相对大小也要比 *Anagale*、*Anagalopsis* 的 P2/小；P3/比 *Anagale*、*Anagalopsis* 的 P3/更为侧扁；P4/齿冠仍象 P3/那样为歪三角形，而不象 *Anagale* 及 *Anagalopsis* 的 P4/那样呈方形；单从 P4/看，*Qipania* 与 *Hsiuannania tabiensis* 最相似，主要区别在于 *H. tabiensis* 有弱的前齿带，后齿带位置低，在原尖后方U形脊后臂之下，很弱小，而不象 *Qipania* 那样在中部。*Qipania* 的 P/3 臼齿化程度与 *Hsiuannania* 相近而比 *Anagalopsis* 高；P/4 与 *Hsiuannania* 的 P/4相近，但有小的下前尖(这与 *Anagale* 相似)。

Qipania 的臼齿冠面构造与 *H. tabiensis* 最相近，但前者上臼齿横宽，后者圆方，前者下臼齿跟座比齿座窄短，后者则跟座长度大于齿座长度。

曾有同行建议将本文所建的 *Qipania* 属归入 *Hsiuannania* 中，鉴于后者标本破残，特别是齿式前半部，在 *Qipania* 是重要特征，而在后者残损，因此笔者先建 *Qipania* 属，待有了更多的材料后再作归与不归的决定。

Qipania yui 的下颌骨较粗壮，联合面长，后端在 P/2 之下，骨体平直，只在 M/2 与 M/3 的间隙之下有较明显的下弯，此处也是下颌骨的最宽处；颏孔至少有两个，前颏孔在 P/1 下方，后颏孔在 P/3 下方。上升支已破，前缘与齿列线几乎成直角；咬肌窝似较深，前边缘显著。上颌骨只保存与右侧齿槽相邻部分及颧突根，腭突部分与腭骨腭突的骨缝距齿槽内缘有 2—3mm 的距离(这与 *Eosigale*、*Anagale* 明显不同)；眶突部分平坦；颧突根在 M2/与 M3/上方，其腹缘伸到 M2/前齿根。颧突被上下分叉的颧骨前端覆盖，眶前窝大而深。颊齿测量数据见表 2、表 3。

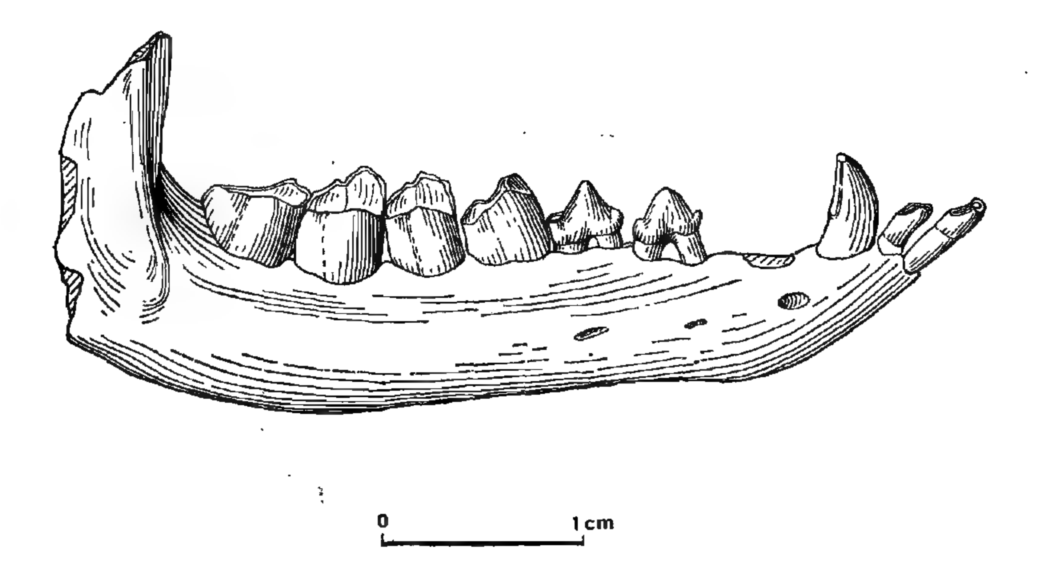


图6　余氏棋盘兽(新属、新种)(V7426)右下颌骨外侧视
Fig. 6 The right mandible of *Qipania yui* gen. et sp. nov., (V7426) buccal view

系统发育分析

Simpson (1931) 创立狉兽科 (Anagalidae) 时，认为狉兽和树鼩关系较近。Bohlin (1951) 和 Mckenna (1963) 在研究新的狉兽类材料后否定了这一观点。Evans (1942) 则认为狉兽类的地位介于树鼩科 (Tupaiidae) 和象鼩科(Macroscelididae)之间。Szalay & McKenna (1971) 将 Anagalidae、Pseudictopidae、Eurymylidae和 Zalambdalestidae 归入一个目：Anagalida，但未讨论各科之间的系统发育关系。Szalay (1977) 更认为狉兽科与 Zalambdalestidae 关系最近。McKenna (1975) 首次用分支系统学方法划分哺乳类高级阶元时，认为狉兽类和象鼩科关系密切，甚至可能是象鼩类的祖先。Novacek (1982, 1986) 基本上继承了 McKenna (1975) 的观点(但 Novacek, 1985 则倾向于狉兽科与啮形类关系密切)。这些研究主要是在对比 *Anagale gobiensis* 及象鼩科的 *Rhynchocyon* 的基础上进行的，而两者在各自的科内均不是最原始的，而且对比的性状也十分有限。从时代和地理分布来看，Anagalidae 限于东亚古新世—渐新世，Macroscelididae 限于非洲渐新世以后，两者之间缺环较大。狉兽类是中生代后期到新生代初期大陆分离背景下土生土长的亚洲真兽类，其系统发育地位只有在与亚洲其他土著真兽类的比较分析中才能确立，也只有在这个背景下才能研究狉兽科内部的系统发育关系。

本文选取 *Kennalestes*、Zalambdalestidae、Astigalidae、Pseudictopidae作为狉兽科的相关类群进行讨论。这几个类群都很小，相互间分化明显，界限清楚，各成单系类群。

本文把迄今归入狉兽科的十三个属及代表有关类群的 *Pseudictops*、*Astigale*、*Zalambdalestes*、*Kennalestes* 作为终端分类单元，分析其相互间的系统发育关系。由于骨骼材料极少，这里全部采用齿列特征。各性状转换系列的演化极向部分以 Novacek(1986)、Butler (1990) 和 Crompton & Kielan-Jaworowska (1978) 的工作为基础，0 为原始性

状,1、2 为衍生性状,演化极向为 0—1—2。

01） 0：门齿数为 3/3;1：I2/2-3，I2-3/2，I2/2;
02） 0：犬齿双根;1：单根不特化;2：单根且特化;
03） 0：犬齿及前几个前臼齿之间齿隙短或无；1：相对较长;
04） 0:P1/双根；1：单根;
05） 0：P/1双根；1：单根;
06） 0：P1/1中等大小；1：较小或退化;
07） 0：P2/双根；1：三根;
08） 0：P3/无后尖；1:有后尖;
09） 0：P4/无后尖；1：有很小的后尖;2：后尖大小如前尖;
10） 0：P4/无前后齿带；1：前后齿带位置低(接近齿槽);2：位置高(接近齿冠顶);
11） 0：P/3无下后尖且下跟座单尖状；1：有下后尖和跟盆;
12） 0：P/4无下后尖;1：下后尖和跟盆都很小；2：下后尖大小如下原尖;
13） 0：颊齿单面高冠现象轻弱；1：显著;
14） 0：后部颊齿釉质不入齿槽；1：入齿槽;
15） 0：后部颊齿齿冠纹饰不易蚀去；1：易蚀去;
16） 0：上下颊齿相互交咬；1：后部颊齿以对咬为主;
17） 0：上臼齿明显横宽；1：轻度横宽；2：亚方形;
18） 0：上臼齿外架较宽；1：无外架但外齿带显著；2：外齿带很弱或消失;
19） 0：上臼齿原尖锥形；1：柱形;
20） 0：上臼齿前后附尖极小；1：前附尖大小如后尖;
21） 0：上臼齿无前后齿带；1：前后齿带位置低(近齿槽)；2：位置高(近U形脊);
22） 0：上臼齿前后齿带窄(包括无齿带)；1：宽;
23） 0：上臼齿外侧齿根不退化；1：很小(相对内侧齿根而言);
24） 0：下臼齿有下前尖；1：下前尖消失;
25） 0：下臼齿三角座明显高于跟座；1：跟座稍低于三角座,但磨蚀后两者高度接近;
26） 0：下臼齿长方形,长度明显大于宽度；1：下臼齿前后向压缩,呈方形或亚方形;
27） 0：下臼齿下次尖锥形,比下原尖小；1：大于下原尖;
28） 0：M/3 下跟座短,下次小尖小；1：下跟座后凸,下次小尖大。

以上各性状系列在十八个终端单元（包括外类群 outgroup）中的分布见性状矩阵(表 4)。

采用系统发育分析软件 Hennig86 对上述矩阵作分析计算,很容易得到最简约分支图。但若不作选择地对十八个单元进行计算，会得到很多的最简约分支图，这是因为有六个单元(打＊者)性状缺失过多所致,若暂先删去这六个单元,就能得到唯一的最简约分支图(图7,I),这和笔者用 Wagner 算法手工计算的结果一致。在该分支图上，节点F很有意义，该点的近裔自性中(10(2)、15(1)、16(1)、18(2)、19(1)、21(2)、25(1)和26(1))包括一系列有适应及功能意义的进化新征，反映了一种较为特化的以上下臼齿对咬为主的咀嚼模式的获得，并且该点之上(包括该点)的单系类群完全由原先归在猩兽科内的属种组成,而范围稍大一点单系(节点E之上)则含有假古猬科的典型分子了。

基于上述理由,笔者把猩兽科界定为节点F之上(包括节点F)的单系类群,它的特征是:

齿式 3-2.1.4.3/3-2.1.4.3,门齿不特化,犬齿小到中等,后几个前臼齿不同程度地臼齿化,颊齿单面高冠显著,冠面纹饰浅，易磨失,某些属种臼齿釉质层进入齿槽,上臼齿方形或稍显横宽,排列紧密无斗隙,原尖高大，成柱形，内缘浑圆，从原尖顶向前后尖伸出U形脊;前后齿带发育,位置高，靠近*U*形脊，磨蚀后，前后齿带之上的冠面联成统一的磨蚀面;无外架,外齿带弱或无；M3/稍退化。下臼齿排列紧密,内缘平直，外缘成双柱形,下前尖退化或消失，齿体近方形,跟座和齿座大小接近,跟座稍窄短，略低于齿座，磨蚀

后，两者高差消失，相邻齿的跟座(前一齿)和齿座(后一齿)共成一个机能单元，与相应上臼齿的内侧对咬，M/3跟座自成一个机能单元，其下次小尖向后伸出。头骨原始；肢骨部分如 Simpson (1931) 所述。

其中的划线部分为狉兽科的近裔自性，即前面所述的10(2)、15(1)、16(1)、18(2)、19(1)、21(2)、25(1)和26(1)。

表 4 狉兽科及相关类群齿列性状分布

Table 4 The distribution of dental traits in anagalids and their relatives

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Outgroup	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kennalestes	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zalambdalestes	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astigale	?	2	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1
Pseudictops	0	1	0	1	1	0	0	0	1	1	1	1	1	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1
* *Chianshania*	?	?	?	?	?	?	?	0	1	1	?	?	0	0	0	0	1	1	0	0	1	0	0	?	?	?	?	?
* *Khashanagale*	?	?	?	?	?	?	?	?	?	?	?	?	1	0	0	0	?	?	?	0	?	?	?	0	0	0	0	1
* *Wanogale*	?	?	?	?	?	?	?	?	?	?	?	?	1	0	0	0	?	?	?	0	?	?	?	0	0	0	0	?
* *Anaptogale*	?	?	?	?	?	?	?	0	0	1	?	?	1	0	1	1	1	1	1	0	1	0	0	?	?	?	?	?
* *Diacronus*	?	?	?	1	?	1	0	?	2	2	?	?	1	0	1	1	1	1	1	0	2	0	0	?	?	?	?	?
* *Stenanagale*	?	?	?	?	?	?	?	?	?	?	?	?	1	0	1	1	?	?	?	0	?	0	?	?	1	1	0	1
Eosigale	0	1	0	1	1	0	0	0	0	2	0	0	1	0	1	1	1	2	1	0	2	0	0	1	1	1	1	1
Huaiyangale	?	?	?	?	?	?	?	?	0	2	0	1	1	0	1	1	1	2	1	0	2	0	0	1	1	1	1	1
Anagale	?	1	0	0	0	0	1	0	1	2	0	2	1	0	1	1	2	2	1	0	2	1	1	0	1	1	1	1
Linnania	?	1	0	0	0	1	0	1	1	2	0	1	1	1	1	1	1	2	1	0	2	1	1	0	1	1	0	1
Angalopsis	?	2	0	0	1	1	0	1	1	2	0	1	1	1	1	1	2	2	1	1	2	1	1	1	1	1	0	1
Hsiuannania	?	2	?	?	1	1	?	?	1	2	1	2	1	1	1	1	2	2	1	1	2	1	1	1	1	1	0	1
Qipania	1	2	0	0	1	1	0	1	1	2	1	2	1	1	1	1	1	2	1	1	2	0	1	1	1	1	0	1

注：？表示该特征缺失。

依照这一定义，*Huaiyangale*、*Eosigale*、*Anagale*、*Linnania*、*Anagalopsis*、*Hsiuannania*、*Qipania* 无疑应归入狉兽科。而以前归入该科的 *Chianshania*、*Anaptogale*、*Khashanagale*、*Wanogale*、*Diacronus*、*Stenanagale* 就不那么肯定了。根据它们保存的极有限的性状信息，笔者将它们用虚线标记在分支图上(图7，II)。如在 *Chianshania* 的有限性状中，具有节点D的近裔自性(17(1)、18(1))，但不具有节点E的近裔自性(13(1))，而且从其保存的有限性状看，*Chianshania* 可能与 *Astigale* 有较近的亲缘关系，被标记在 *Astigale* 这个分支上，笔者认为可将其暂归到 Astigalidae 中。其它各类群按同样方法标记。这样，*Khashanagale* 和 *Wanogale* 被标记在节点E处，和狉兽科及 *Pseudictops* 共处一个四分点处，它们不具有狉兽科的近裔自性(与狉兽科的近裔自性15(1)、16(1)、25(1)相对，它们具有15(0)、16(0)、25(0))，应排除在狉兽科之外，分类位置待定。*Anaptogale*、*Diacronus*、*Stenanagale* 标记在节点F处，暂先归入狉兽科。但它们保存的性状信息太少，不能保证它们一定处在真兽类系统发育这一分支上(指本文研究的 Astigalidae-Pseudictopidae-Anagalidae 这个单系类群)。如 *Diacronus* 具有粗壮的

上颌骨颧突，上颌骨腭突很宽，P3/双根，P4/后尖大小如前尖，其分类位置一开始就是暂

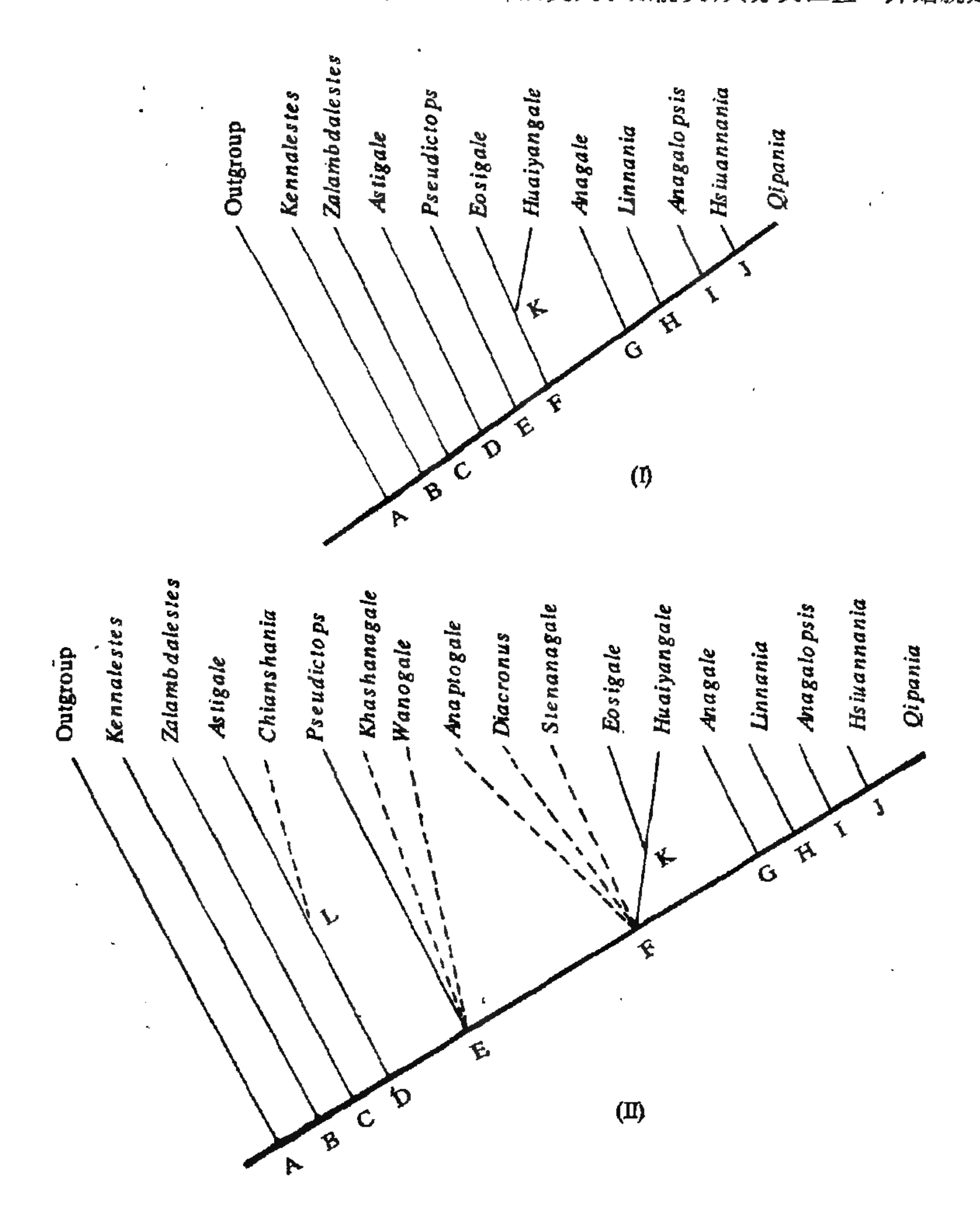


图 7　砸兽科及相关类群的系统发育关系

Fig. 7 The cladograms for genera of Anagalidae and their relatives

(I) 用 Hennig 86 得到的十二个单元的分支图　树长=53 CI指数=0.66

The cladogram for 12 taxa generated by Hennig 86, data from table 3

(II) 在左图基础上用虚线标记另六个单元得到的分支图

The cladogram for 18 taxa generated from the cladogram (I) with the rest 6 taxa marked

支持各节点的性状 (The characters supporting each node):

B: 10(1); C: 9(1); D: 2(1) 4(1) 5(1) 17(1) 18(1) 21(1) 28(1); E: 12(1) 13(1); F: 10(2) 15(1) 16(1) 18(2) 19(1) 21(2) 25(1) 26(1); G: 4(0) 5(0) 22(1) 23(1); H: 6(1) 8(1) 14(1); I: 2(2) 5(1) 20(1) 24(1); J: 11(1) 12(2); K: 24(1) 9(0) 27(1)

定的(徐钦琦,1977);*Anaptogale* 也有类似情形(徐钦琦,1977; 丁素因、童永生,1979;童永生,1979)。在没有新的证据以前,为避免混乱,仍按原描述者的意见将它们暂归狉兽科。

这样,在狉兽科内部,*Huaiyangale* 和 *Eosigale* 关系最密切(共有 9(0)、24(1)、27(1)),组成一个单系类群;釉质层深入齿槽的单元也组成一个单系类群(其中 *Qipania* 和 *Hsiuannania* 组成一个单系 J,*Anagalopsis* 和单系 J 组成单系 I,*Linnania* 和单系类群 I 是姐妹群),但釉质层不入齿槽者不组成单系类群,*Anagale* 和釉质层深入齿槽的那些类群组成单系类群;因此,依釉质层是否深入齿槽划分出的两个类群并不都是自然类群。

从分支图来看,假古猬科(图上有其典型代表 *Pseudictops*)与狉兽科关系最近,丽狉科(以 *Astigale* 为代表)次之。就目前的认识来看,狉目不是一个单系类群,因为随着认识水平的不断提高,不少真兽类类群被认为和狉目的这一科或那一科关系密切;笔者倾向于认为假古猬科(或它所代表的分支)是狉兽科的姐妹群。

结 语

本文较详细地描述了两件新材料,定为狉兽科的两个新属各一种。从齿式特征看,*Eosigale* 相对原始些,而 *Qipania* 很特化。从头骨看,*Eosigale* 的大部分头骨特征仍处在真兽类的原始状态,据此可以认为狉兽类是较原始的真兽类,而 *Eosigale* 是迄今发现的最原始的狉兽科分子。

根据应用 Hennig 86 软件得到的系统发育分支图,本文重新界定了狉兽科范围,确定狉兽科作为一个单系类群,以一系列反映一种较为特化的以上下臼齿对压研磨为主的咀嚼模式的获得的进化新征为近裔共性。将 *Chianshania*、*Khashanagale*、*Wanogale* 排除出狉兽科,把 *Anaptogale*、*Diacronus*、*Stenanagale* 作为可疑成员暂时归入狉兽科,并给出了明确的图示,指出在亚洲古老真兽类中,狉兽科和假古猬科(或其代表的分支)的系统发育关系最近。

狉兽科作为亚洲古老真兽类的重要成员,其地层意义、生物地理特征和行为生态习性都是很有意义的课题,有待于作更深入的研究。

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TWO NEW GENERA OF ANAGALIDAE (ANAGALIDA, MAMMALIA) FROM THE PALEOCENE OF QIANSHAN, ANHUI AND THE PHYLOGENY OF ANAGALIDS

Hu Yaoming
(*Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica*)

Key words Qianshan, Anhui; Paleocene; Anagalidae; Phylogenetic analysis

Summary

Anagalidae is an important group of the endemic eutherians in the Asian early Cenozoic. It has been sixty years since Simpson(1931) created the family Anagalidae and described the first monotypic genus *Anagale* (which was later revised by McKenna, 1963). Up to now, there are 13 genera, including 18 species, are assigned to Anagalidae. The earliest member occurs in Early or Middle Paleocene while the last in the Oligocene.Distributed in Guangdong, Jiangxi, Hunan, Shaanxi, Anhui, Gansu, Nei Mongol of China and Gashato of Mongolia, the Anagalidae is a group of long continuation and wide distribution although the assignment of some genera may be questionable. The evolution of anagalids is among the essential for understanding of endemic Asian eutherians (Table 1).

This paper describes two relatively well-preserved specimens collected in 1990—1991 from the Middle Paleocene of Qianshan Basin, Anhui,which represent two new genera of Anagalidae, and studies the phylogeny of anagalids and emends the family Anagalidae.

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Systematic Description

Order Anagalida Szalay & McKenna, 1971
Family Anagalidae Simpson, 1931, em.
Eosigale gen. nov.

Genotype *Eosigale gujingensis* gen. et sp. nov.

Diagnosis Close to *Linnania* in size; structure of skull and lower jaw similar to that of *Anagale* but more generalized in construction. Skull comparatively narrower and lower than that of *Anagale*, lacrimal tubercle absent, only one lacrimal foramen present, orbit open with weak postorbital process, the infraorbital canal short, and the antorbital fossa small and shallow. Horizontal ramus of mandible slender, while ascending ramus thin and high.

Dental formula: 3?.1.4.3/3.1.4.3. Incisors and canines similar to those in *Anagale*, but cheek teeth more like those in *Huaiyangale* although with distinct differences: P1/1 single-rooted, P4/ without metacone, P/3 slightly molariform and P/4 with single-cusped talonid; upper molars not greatly transversely elongated and low due to the height < length < width; the pre-and postcingula of upper molars narrow; cusps of low molars blunt-conical, with protoconid taking the outer part while metaconid the inner part of trigonid, the talonid basins of low molars very shallow; the enamel layer of molars very thin, covering the upper part of the crown; the degree of unilateral hypsodonty less than that of all other known anagalids.

Etymology *eos*-, a Latin prefix, means dawn, primitive; -*gale* is from *Anagale*; the genus' name means primitive anagalid.

Eosigale gujingensis gen. et sp. nov.

(figs. 1—4; pl. 1, 2)

Holotype An anteriorly perfect skull of not very old individual with clear outline and a pair of partly broken mandibles of the same individual with most teeth (IVPP specimen no. V7425).

Horizon and Locality Upper Member, Wanghudun Formation, Middle Paleocene; Fulaowu, Gujing Township, Qianshan County, Anhui Province.

Diagnosis As for the genus.

Etymology Gujing is the name of an area where the specimens were collected.

Description and Discussion The type was deformed during preservation, and the middle vertical plane of the skull slopes to right, but the shape of many bones and the construction of most teeth are clear.

1. Skull The part of skull anterior to the orbit is well preserved. The skull is low and narrow. The snout is short while the posterior half of the facial region is very wide.The orbit is large, facing laterally. The braincase is damaged, which seems to be less expanded than those of *Anagale* and *Anagalopsis*. The temporal region, the auditory bulla, and the occipital region are also damaged.

Nasal: Right nasal is well preserved. It is elongated and slender, slightly expanded anteriorly and distinctly expanded posteriorly. The posterior tip, extending more posteriorly than the anterior rim of the orbit, covering the frontal of the same side and being present medial to the frontal foramen, does not merge with its opposite mate. The nasal contacts premaxilla, maxilla, frontal and opposite nasal.

The nasals of *Eosigale* are similar to those of *Anagale* and *Anagalopsis*, but more elongated and slender with posterior tips separated from each other.

Premaxilla: The premaxilla is poorly preserved so that only a few details can be determined. The sharp posterodorsal process extends to a point above the root of P1/. The palatal exposure is damaged, but it is obvious that this element is small, correlating with the moderate or small incisor foramina.

In *Eosigale*, the premaxilla is possibly typical of anagalids because the premaxillae of *Anagale* and *Anagalopsis*, the only two previously known anagalids with well preserved skull, are similar to that of *Eosigale*.

Maxilla: All elements of the maxilla are somewhat preserved. The facial exposure is very large, and occupies most of the facial region, owing to the weak posterior extension of the premaxilla and the slender nasals. It contacts premaxilla, nasal, frontal, lacrimal, and jugal. A stout and short zygomatic process extends posterolaterally from the posterolateral end of the facial exposure. On the surface anterior to the zygomatic process there is a moderate and very shallow antorbital fossa with the posterior border marked by the anteriorly bifurcate process of the jugal. The infraorbital canal is about 6mm long, with the anterior opening above the embrasure between P3/ and P4/ while the posterior opening is on the anterior wall of the orbit above the embrasure between M1/ and M2/. This canal is slightly shorter and larger than that of *Anagale* and *Anagalopsis*. The palatal process of the maxilla occupies more than two-thirds of the palate, due to the small premaxilla and palatine in this region. The maxillary-palatine suture runs from the posterior edge of palate, first parallel to the dental row, then opposite the posterior edge of M1/, arching in a suture to the middle line at a point possibly opposite the embrasure between P4/ and M1/. The orbital process of the maxilla is extensive, but only acts as the floor of the orbital fossa.The maxilla in this region is bounded dorsally by the jugal and the orbital face of the lacrimal and medially by the orbital process of the palatine; thus the maxilla here is effectly excluded from contact with the frontal. The posterior opening of the infraorbital canal lies within the orbital process of the maxilla, just beneath the maxillary-lacrimal suture.

Although details of the maxillae in *Anagale* and *Anagalopsis* are still unknown, it seems reasonable to say that their maxillae are similar to that of *Eosigale* according to the figures and plates.

Lacrimal: This is a simple element. The facial process is small triangular with an outer tip adjoining to the tip of the dorsal process of the jugal on the antorbital rim, an anterior edge contacting the facial process of the maxilla, an inner edge contacting the frontal and a posterior edge acting as the middle part of the antorbital rim. This facial process is excluded

from contact with the nasal due to the maxillary (facial process)-frontal contact. The orbital process of the lacrimal is also triangular, but somewhat larger than the facial process. There is a single lacrimal foramen at the outer corner, just above the posterior opening of the infraorbital foramen. Although poorly preserved, it is discernible that this foramen, round and moderate, lies within the orbital process and opens posteriorly. There is no evidence for the presence of a lacrimal tubercle, which is distinct in *Anagale*. The orbital process contacts the jugal, maxilla (orbital process), palatine and frontal although the inner edge is poor defined, due to damage. A functionally unknown groove is present on the orbital face just under and parallel to the antorbital rim, with some pits in it.

It is common for *Eosigale* and *Anagale* that the lacrimal has a small facial process with no contact with the nasal and a slightly larger orbital process contacting the palatine, But *Anagale* has two equal lacrimal foramina and a distinct lacrimal tubercle while *Eosigale* has only one lacrimal foramen and no tubercle.

Palatine: The palatine is poorly preserved. Its suture with the maxilla in the palatal region has been mentioned above. There is a small anterior (or middle?) palatine foramen at the point opposite M2/. The foramen opens anteriorly into a shallow trough continuous to a faint sulcus extending anteroposteriorly for most of the length of the palatal process of the maxilla. The postpalatine torus is distinct. A distinct notch on the posterior edge of the palatine and a small canal in the wing of the postpalatine torus may act as the posterior palatine canal of some other mammals. The orbital process is extensive, acting as the medial vertical wall of the orbit. The boundary between the orbital floor and vertical wall is also the maxillary-palatine suture in this region. Near and parallel to this suture there is a recess on the palatine. A small oblate foramen (tentatively considered as dorsal palatine foramen) and a larger circular sphenopalatine foramen are on the floor of the recess. Although the anterior region of the palatine is damaged, it is discernible that the edge of the maxilla is straight and smooth while the broken edges of the palatine and lacrimal indicate their extending and contacting with each other. Thus it is impossible that the maxilla contacts the frontal.

Frontal: The frontal acts as the skull roof in the orbital region. It is low and flattened, and rectangular in dorsal view. Its anterior edge, present just anterodorsal to the antorbital rim, contacts the lacrimal, maxilla and nasal. It is constricted posteriorly at a point just anterior to the frontal-parietal suture, and this constriction may correspond with the boundary between the olfactory bulb and cerebral hemi sphere. The postorbital process is blunt. From the process extends posteriorly a weak and blunt supratemporal crest, passing cross the frontal-parietal suture and then merging with its opposite mate into a single sagittal crest posteriorly. There is a foramen near the posterior tip of the nasal but wholly within the frontal, which is similar to what Simpson (1931) called a vascular foramen in *Anagale*. The orbital exposure of the frontal is unfortunately damaged, but it is almost certain that the frontal is excluded from contact with the orbital process of maxilla, due to the lacrimal-pala tine contact.

The broad and elongated frontal with distinct postorbital process in *Anagale* and *Anagalopsis* is distinctly different from that of *Eosigale* mentioned above.

Parietal: The parietals are fused with a low sagittal crest present along the fused suture. The outer wall of the parietal is narrow and slightly convex, reflecting less expansion of the cerebral hemisphere. Other details of the parietal are damaged.

Although poorly preserved, it is still clear that the parietal in *Eosigale* is primitive, comparing with the distinctly convex ones of *Anagale* and *Anagalopsis*.

The other elements of the skull are unfortunately damaged during preservation; thus no more details can be described except a short, trapezoid, relatively less damaged bone ventral to the braincase termed as basisphenoid.

2. Mandible The mandible of *Eosigale* is similar to that of *Anagale* but shows distinct differences. The symphysis in *Eosigale* extends posteriorly to beneath the posterior root of P/2 while in *Anagale* beneath the root of P/1. The hook-like angular process projects backwards and upwards while directly backwards in *Anagale*. The positions of mandibular condyle and foramen are lower than those in *Anagale*. The anterior edge of the ascending ramus is steeper than that in *Anagale*.

The distinct characters of *Eosigale* skull can be summarized as follows:

01) The snout is of moderate length;
02) The orbital fossa is large but still smaller than the temporal fossa;
03) The braincase is flat and might be small;
04) The premaxilla is small in size, and its posterodorsal process extends to a point above the root of P1/, not in contact with nasal;
05) The nasal is slender and moderate in length;
06) The incisor foramina are moderate or small in size;
07) The frontal-maxillary suture in the facial region is moderate long;
08) The facial process of maxilla is distinctly larger than that of premaxilla and nasal;
09) The lateral maxillary-jugal contact is somewhat bifurcate;
10) The infraorbital canal is moderate in length and caliber;
11) Antorbital fossa is shallow and small;
12) The maxilla has a much more extensive palatal process than the premaxilla;
13) The orbital process of maxilla acts as the orbit floor while being excluded from the middle vertical wall;
14) Postpalatine canal is absent;
15) The posterior margin of the palate is just between the last molars;
16) The postpalatine torus is distinct;
17) The sphenopalatine foramen and the dorsal palatine foramen are possibly in the same recess.
18) The facial process of lacrimal is too small to contact the nasal;
19) The lacrimal contacts the palatine in the orbit;
20) A single lacrimal foramen opens posteriorly within the orbit, and the lacrimal tubercle is absent;
21) A vascular foramen is present within frontal medial to the posterior tip of the nasal;

22) The postorbital process is weak and the supraorbital foramen is absent;
23) The supraorbital, the supratemporal and sagittal crests are low and blunt;
24) The supratemporal crest is present on the frontal;
25) The jaw condyle is comparatively low.

Although the skull is obscured posteriorly due to damage, it still can be concluded from the characteristics listed above that *Eosigale* is possibly the most primitive anagalid.

3. Dentition The tips of premaxillae and mandibles are incomplete so that the presence of some incisors cannot be determined. There are four roots in alveoli anterior to P/1 in right mandible, thus there are 3 lower incisors certainly; two upper incisors present in left premaxilla; and according to the width of the snout and the number of lower incisors, I1/ should be present, so the formula is 3?.1.4.3/3.1.4.3.

If present, I1/ should be small. I2/ is small, styliform, single-rooted. It is almost erect, procumbent only in the slightest degree with the crown not expanded. There are two wear facets on the lingual side of the crown; the anterior facet results from the occlusion with I/2 while the posterior one, the main facet, with I/3. I3/ is only a little larger than I2/and probably of the same structure.

The upper canine is the highest in the upper dentition. It is single-rooted, conical, and stouter than incisors and P1/. It is almost erect with the slight posterior slope.

P1/ is small, single-rooted.The crown is composed of a single cusp with rounded sides, a steep anterior slope and a less steep weak posterior cutting edge without any swelling. P2/ is larger than P1/ and double-rooted. The crown is similar to that of P1/ but wider and with a swelling at the base of not very distinct posterior cutting edge. P3/ is three-rooted. The crown is triangular in outline. There is only one outer main cusp, preceded and followed by small styles at the bases of anterior and posterior cutting edges. It is larger and functionally more important than the protocone supported by the lingual root. The protocone is mid-lingually placed, with weak crests toward the para- and metastyle. P4/ is structurally similar to P3/, but its crown is subquadrate due to the protocone being stouter than the main outer cusp and the presence of weak pre- and postcingulum at the base of protocone, Additionally, the unilateral hypsodonty of P4/ is more distinct than that of P3/. The main wear facet of P4/ (similar to P3/) is above the postcingulum.

The upper molars are subquadrate, transversely elongated, the crown height $<$ the length $<$ the width. The unilateral hypsodonty is obvious although the enamel is very thin and covers the upper parts of crowns. The crowns are much worn, only M3/ still shows much of the crown pattern, but the structures of upper molars should be similar. There are three main cusps, plus small para- and metastyle. Conules are absent, but weak precingulum and slightly wider postcingulum are present nearly as high as the base of main cusps. The small bulbous paracone and metacone are almost at the outer edge of the crown although their apexes tilt lingually. The steep-sided and lingually sloped protocone is slightly larger and somewhat prismatic.

The pre- and postcrista are visible but there are no visible cristae between para- and metacone. M2/ is the largest while M3/, with oblique external border and very small metacone, is the smallest. The unilateral hypsodonty of upper molars is more distinct than on P4/ but the enamel still far from alveoli. There are short diastema between the anterior premolars for the interlocking occlusion of the anterior half of the dentition, while the close presence of P4/-M3/ results in the opposite occlusion on wearing surfaces.

There are only three roots for lower incisors in the right mandible which show that single-rooted, styliform lower incisors are more procumbent than the upper ones and I/1 is very small and nearly meets its mate of the opposite side.

The lower canine is also known from the root on right mandible. It is single-rooted, slightly procumbent and a little larger than its neighbours.

P/1 is single-rooted, styliform, sides-round and slightly procumbent. P/2 is double-rooted. Its transversely compressed crown has a steep anterior cutting edge and a generally inclined posterior slope, which meets a low heel cusp. P/3 is similar to P/2 in structure but somewhat larger and stouter. Its apex is preceded by a very small blade at the anterolingual base, acting as paraconid and followed by a steep posterior slope which bears two weak crests, one lingual and extending to the anterolingual base of the heel, the other short and connecting the middle of protoconid base with the heel. P/4 is similar to P/3 but with a more distinct paraconid blade, a wider single-cusped eel,and a small metaconid separated from the protoconid apex; thus the crown is subquadrate in occlusal view.

Lower molars closely appressed. They are double-column in buccal view (M/3 three-columned due to the posteriorly projecting hypoconulid) while lingually flattened with distinct unilateral hypsodonty. The crowns are worn, but the bases of cusps reveal most of the structure. M/1 and M/2 are the same in structure but M/2 is somewhat larger. The trigonid is compressed anteroposteriorly and short as is also the talonid, while the latter is slightly lower and wider. The paraconid is absent. The bulbous protoconid occupies the buccal half of the trigonid while the also bulbous metaconid occupies the lingual half with a short protolophid connecting their apexes at the posterior edge of the trigonid. The metaconid is somewhat larger than the protoconid. The hypoconid, slightly larger than the protoconid, occupies the buccal half of the talonid while a small and shallow talonid basin anteriorly and a small entoconid posteriorly share the lingual half. A short cristid obliqua connects the apex of the hypoconid with the center of the protolophid. The hypoconulid is absent. The trigonid of M/3 is similar to those of M/1—2 while its talonid is comparatively long due to the large and posteriorly projecting hypoconulid. The hypoconid is subequal to the protoconid in size but the entoconid is absent while a shallow and open talonid basin is present.

The dentition of ***Eosigale*** is of typically anagalid type. Generally, its incisors are similar to those of ***Anagale***, the only previously known anagalid preserving the incisors. Its moderate canines are also similar to those of ***Anagale***, while distinctly differ from the large ones of ***Anagalopsis***. Its cheek teeth are most similar to those of ***Huaiyangale*** but with distinct differences. The premolars are less molarized

than those of all the other known anagalids. Comparison with the previously known anagalids shows that the characters, such as the low crown of upper molars, weak cingula, bulbous lower molar cusps, the very thin enamel and the slightly unilateral hypsodonty, etc., are distinct *Eosigale*.

Qipania gen. nov.

Genotype *Qipania yui* gen. et sp. nov.

Diagnosis Dental formula: 2.1.3.4/2.1.3.4. The incisors small; the upper ones erect and the lower ones procumbent. Canines large but comparatively smaller than those of *Anagalopsis*. The cheek teeth similar to those of *Hsiuannania* and *Anagalopsis* but the differences still distinct. P1/1 degenerative while P1/ double-rooted and P/1 single-rooted; P/4 with small but visible paraconid, the upper molars more transversely elongated than those of *Anagalopsis* and *Hsiuannania*, and with narrow pre- and postcingulum and nearly invisible paraconules; the talonids of M/1—2 slightly shorter and narrower than trigonids; the lingual enamel of upper molars and the enamel all around the lower molars into the alveoli.

Etymology The genus name follows that of the locality of specimen of the genotype.

Qipania yui gen. et sp. nov.

(figs. 5,6; pl. I, 2)

Holotype A pair of mandibles and broken maxillae of the same adult individual with most of teeth (V7426).

Horizon and locality Upper member, Wanghudun Formation, Middle Paleocene; beside the road near Qipan-cun, Taopu Township, Qianshan County, Anhui Province.

Diagnosis As for the genus.

Etymology The species is named after Prof. Yu Ben'ai who gives our research group much help in the field work for many years.

Description and discussion There is no evidence for the presence of I1/, while I2/ and I3/ are small in size and similar in structure. Their crowns are conical, and shorter than their conical roots. The main wear facets are on the anterior side of the crowns.

The upper canine is single-rooted and horn-like. The crown is slightly procumbent while its tip projects downwards and slightly backwards.

The upper premolars are distinctly different from each other. P1/ is small, double-rooted. Its buccolingually compressed crown has a single cusp with a steep posterior cutting edge and a less steep anterior slope. P2/ is also double-rooted, similar to P1/ in outline but two times as large as P1/. Its steep anterior slope possesses a slight swelling while the less steep posterior cutting edge possesses a small but distinct metastyle; the crown is wider posteriorly. P3/ is three-rooted and the lingual

root is more forward than the anterolabial root. The protocone is lower and less important than the paracone while the metacone is only a very small cusp connecting with the paracone by a crista. A weak postcingulum extends from the base of the protocone to near the base of the metacone while the crown is steep anteriorly. P4/ is larger than P3/ but structurally similar to the latter, although with some details different. The protocone of P4/ is massive with all sides vertical, the postcingulum is wider than that of P3/, and a small paraconule is present at the anterolingual base of the paracone.

The upper molars are much worn. They are similar in crown pattern while M2/ is larger than the other two. M1—2/ are subquadrate with the width > the length, while M3/ is somewhat round due to the degeneration of the crown posterolabially. The crown pattern is similar to that of ***Hsiuannania tabiensis*** while pre- and postcingulum are much more slender than those of the latter. Additionally, the upper molars of ***Qipania yui*** have very small paraconules.

The lower incisors, two in number, are small, single rooted and styliform. They are distinctly procumbent with the main wear facets on the posterior crown walls (same as lingual for I/2 and posterolabial for I/3), thus it is certain for this specimen that the lower incisors hold the upper ones during occlusion, but it is unknown whether this is a group trait or only the individual anisotrophy (morbidness).

The lower canine is similar to the upper one in outline but smaller.

The P/1 is single-rooted and small. The labiolingually compressed crown apex is proceeded by a slight swelling and followed by an even smaller swelling. The P/2 is double-rooted. Its crown is similar to that of P/1 but the anterior swelling is distinct and a single-cusped heel is present instead of the small posterior swelling. P/3 is larger and stouter than P/2 and beginning to be molarized. Its protoconid is large with a small paraconid at its anterolingual base and a little higher metaconid at the posterolingual base. The talonid is low and very small with the hypoconid and the entoconid. The P/4 is more molarized than P/3, and quadrate in occlusal view, while the talonid is equal to the trigonid in size. The metaconid is larger than the protoconid, while the paraconid is almost invisible. The talonid basin is shallow with an oblique crest, a small hypoconid, a smaller hypoconulid and a slightly larger entoconid.

The lower molars are so much worn that it is difficult to describe more details of the crown pattern, which is hypothesized to be similar to those of ***Anagale*** and ***Anagalopsis***. The M/1—2 are quadrate in occlusal view with talonids slightly shorter and narrower than trigonids while M/3 looks like a pentagon due to the large hypoconulid projecting to the rear. There is no evidence for presence of paraconids and precingulids.

Corresponding with the unilaterally buccal high-crowned nature, P/4–M/3 show that the labial enamel of the teeth extends deeply down the roots while the lingual enamel only arrives at the alveoli.

Generally, the number and the occlusal pattern of incisors of ***Qipania*** are distinctly different from those of ***Anagale*** and ***Eosigale***, the only other two anagalids

with incisors preserved. The canines of *Qipania* are large but relatively smaller than those of *Anagalopsis.* The cheek teeth of *Qipania* are most similar to those of *Hsiuannania* and *Anagalopsis* but with distinct differences mentioned above.

The lower jaw of *Qipania yui* is stout, similar to that of *Hsiuannania maguensis.* The largest mental foramen is beneath P/3, and two small ones are anterior to it, one beneath the root of P/1 and the other beneath the anterior root of P/2. The ascending ramus of the mandible is unfortunately broken.

Remarks Some colleagues advised me to create a new species of *Hsiuannania* instead of a new genus for the material here described, But the poorly preserved specimens of all *Hsiuannania* species make it difficult to compare the whole dentitions of *Hsiuannania* and the newly found material, especially the anterior part, which is important in diagnosing the genus *Qipania.* More evidence is needed to determine whether they are similar enough to be include in one genus or distinctly different. I believe it would be better to create a new genus for the relatively well preserved specimen; and what is most important is to describe specimens and then to make an analysis of the genealogical relationships of the taxa they represent, no matter what happens.

Phylogenetic Analysis

Simpson (1931) tended to relate *Anagale*, which was the type and only known genus of the family Anagalidae then, to Tupaiidae. Evans (1942) concluded that anagalids (equal to *Anagale* at that time) are intermediate between tupaiids and macroscelidids after comparing *Anagale* with macroscelidids. After bringing out new details of anagalid anatomy, Bohlin (1952) and McKenna (1963) denied tupaiid special relationship of anagalids and simply left Anagalidae as Mammalia, *incertae sedis.* Szalay & McKenna (1971) created an order Anagalida for some Asian endemic eutherians: Anagalidae, Pseudictopidae, Eurymylidae, Zalambdalestidae and possibly Didymoconidae as well, but made no phylogenetic analysis. When McKenna (1975) made the first higher-level phylogenetic classification of Mammalia, he simply related Anagalidae to Macroscelididae with no more interpretation. Novacek (1982, 1986) supported McKenna (*ibid.*) with some characteristic evidences although in an other paper (Novacek, 1985) he prefers the anagalids Glires relationship. Additionally, Szalay (1977) suggested affinity between anagalids and zalambdalestids.

No matter what relationship of anagalids was endorsed, it is common for all these papers that the *Anagale* is the representative of the family Anagalidae. But now more than ten genera, most of which are Paleocene in age, are assigned to Anagalidae. It is clear that *Anagale* is not primitive in the family, and the phylogenetic result of Anagalidae based on *Anagale* is probably dubious. The geographic and age gap between anagalids and macroscelidids also makes the anagalids-macroscelidids relationship questionable. The author prefers that anagalids itself, as well as the pseudictopids and astigalids, originate from some older lineage of Asian endemic eutherians, and its phylogenetic status should be determined among the Asian endemic eutherians. Meanwhile, it is also important to redefine the family as a monophyletic group. This section will discuss the phylogenetic relationship of all genera assigned

to the Anagalidae and those among Asian endemic eutherians, such as *Kennalestes*, *Zalambdalestes*, *Pseudictops* and *Astigale*, etc., at the genus-level. The discussion will be based on the dental character analysis with the polarity argument by using outgroup comparison method partly on the basis of the work of Crompton & Kielan-Jaworowska (1978), Novacek (1986) and Butler (1991).

Here is the list of character transformation series with 0 as the primitive character and 1,2 as the derived, while the polarity is 0—1—2.

01) 0: I3/3; 1: I2-3/3, I2/2-3 or I2/2;

02) 0: canines double-rooted; 1: single-rooted and moderate; 2: single-rooted and large;

03) 0: diastema between anterior premolars and canine short or absent; 1: relatively longer;

04) 0: P1/ double-rooted; 1: single-rooted;

05) 0: P/1 double-rooted; 1: single-rooted;

06) 0: P1/1 moderate; 1: small and degenerative;

07) 0: P2/ double-rooted; 1: three-rooted;

08) 0: P3/ without metacone; 1: metacone present;

09) 0: P4/ without metacone; 1: very small metacone present; 2: metacone as large as paracone;

10) 0: P4/ without pre- and postcingulum; 1: pre- and postcingulum present but low positioned; 2: high positioned;

11) 0: P/3 without metaconid and the talonid single-cusped; 1: the metaconid and the talonid basin present;

12) 0: P/4 without the metaconid; 1: metaconid and talonid basin small; 2: metaconid as large as protoconid;

13) 0: the unilateral hypsodonty of posterior cheek teeth not distinct; 1: distinct;

14) 0: the enamel of posterior cheek teeth not down into alveoli; 1: down into alveoli;

15) 0: crown pattern of posterior cheek teeth relatively wear-resisting; 1: the crown pattern obliterated early in wear;

16) 0: the interlocking occlusion of cheek teeth permitted; 1: the occlusion of posterior cheek teeth mainly surface-to-surface crushing;

17) 0: the upper molars greatly transversely elongated in occlusal view; 1: less transversely elongated or subquadrate; 2: quadrate or rectangular;

18) 0: upper molars with wide stylar shelves; 1: stylar shelves absent but stylar cingula distinct; 2: stylar cingula weak;

19) 0: upper molars protocone conical-sectorial; 1: prismatic with sides round;

20) 0: upper molars para- and metastyle small; 1: parastyle as large as metacone;

21) 0: upper molars lingual cingula absent; 1: present but low positioned (near the alveoli); 2: present and high positioned (far from the alveoli);

22) 0: upper molars pre- and postcingula narrow; 1: wide;

23) 0: upper molars outer roots small but not regressive; 1: outer roots regressive and the crowns supported mainly by the large inner roots;

24) 0: lower molars paraconids present; 1: absent;
25) 0: lower molars trigonids distinctly taller than talonids; 1: talonids nearly as high as trigonids, especially after wear;
26) 0: lower molars rectangular with length distinctly larger than width; 1: subquadrate or quadrate because compressed anteroposteriorly;
27) 0: lower molars hypoconids conical and smaller than protoconids; 1: larger than protoconid;
28) 0: M/3 talonid short with small hypoconulid; 1: elongated with large and posteriorly projecting hypoconulid.

Accordingly, the character matrix of the above transformation series distributed in 18 taxa (include the outgroup for comparison) is given in the Table 4.

The most parsimonious cladogram is easily obtained with the aid of computer. The cladogram can be generated by phylogenetic analysis software Hennig 86. Some algorithms generate too many equally parsimonious cladograms due to six taxa (*Chianshania*, *Khashanagale*, *Wanogale*, *Anaptogale*, *Diacronus*, *Stenanagale*) with so many characters missed. When these taxa are deleted, only one most parsimonious cladogram (Fig. 7, I) is obtained. In this cladogram, the monophyletic group above the node F comprises those assigned to Anagalidae with a series of meaningful synapomorphies, and the somewhat larger monophyletic groups will include the typical members of the other families. The deleted taxa can be marked on the cladogram with dotted line (Fig. 7, II). For example, *Khashanagale* possesses some apomorphies of node E, but does not possesses any apomorphies of node F, so it is marked at node E. All the other deleted taxa are marked likely.

If the family Anagalidae is redefined as the above monophyletic group (above the node F in the cladogram II), which possesses 10(2), 15(1), 16(1), 18(2), 19(1), 21(2), 25(1) and 26(1) as its apomorphies, the defining characters of the family will be:

Dental formula: 2—3.1.4.3/2—3.1.4.3. Incisors unspecialized. Canines single-rooted, moderate or large. Posterior premolars somewhat molarized. The unilateral hypsodonty of cheek teeth distinct, with the enamel down into alveoli in some genera. The molars with the crown pattern obliterated early in wear. The upper molars quadrate or slightly transversely elongated, associated closely with no embrasures along the lingual side. The P4—M3/pre-and postcingula high, near the crista, and the upper molar protocones prismatic with all sides round. The lower molars quadrate and closely associated with the paraconids regressive or absent. The lower molar talonids nearly as high as the trigonids, especially after wear, so that the talonids and trigonids of neighboring teeth form a surface onto which the lingual crowns of the upper molars crush. The skeleton characters are still as Simpson (1931) described.

The author would like to indicate that the synapomorphies of the family Anagalidae correspond with the origination of a "crush-mainly" occlusion pattern in history.

According to this redefinition, *Huaiyangale*, *Eosigale*, *Anagale*, *Linnania*, *Anagalopsis*, *Hsiuannania* and *Qipania* are essential members of the family Anagalidae;

Anaptogale*, *Diacronus and ***Stenanagale*** are questionable members included in the family while ***Chianshania*, *Khashanagale*** and ***Wanogale*** should be excluded from the family. The latter six groups are only marked on the cladogram for the moment, and more evidences are needed to determine their status in the phylogeny of primitive eutherians.

Still, according to the cladograms in Fig. 7, the family Pseudictopidae, represented by ***Pseudictops*** in the cladograms, is most closely related to the Anagalidae while the Astigalidae, represented by ***Astigale*** in the cladograms, secondarily.

The author accepts that the order Anagalida, with all mentioned families included, is not a monophyletic group because more and more eutherium groups are being related to some subgroups of the order, but the close relationship between the family Anagalidae and the branch represented by Pseudictopidae is acceptable and confirmable.

Within the family Anagalidae, ***Eosigale*** and ***Huaiyangale*** combine a monophyletic group with synapomorphies 24(1) and 27(1). ***Anagale*** is the sister group of the monophyletic group composed by those with the cheek teeth enamel down into alveoli. ***Hsiuannania*** and ***Qipania*** combine a specialized monophyletic group with ***Anagalopsis*** as its sister group.

Conclusion

The paper describes two specimens representing two new genera of the family Anagalidae: ***Eosigale***, a primitive one, and ***Qipania***, a specialized one. ***Eosigale*** is possibly the most primitive anagalid, according to its craniodental features.

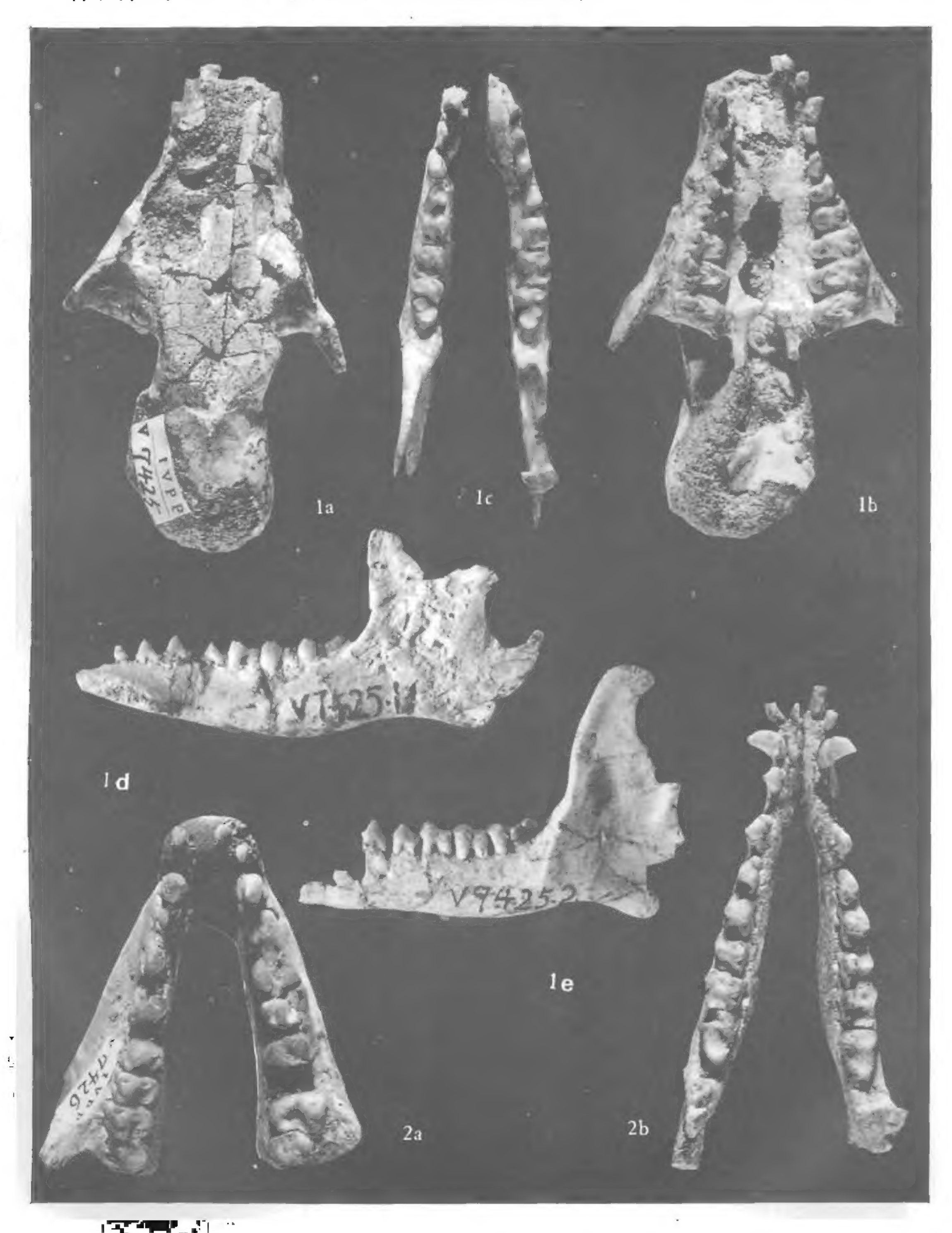
A cladogram, based on dental features, is generated with the aid of phylogenetic analysis software Hennig 86. Accordingly, the family Anagalidae is redefined as a monophyletic group with 10(2), 15(1),16(1), 18(2), 19(1), 24(1), 25(1) and 26(1) as its apomorphies. ***Chianshania*, *Khashanagale*** and ***Wanogale*** are excluded from the family while ***Anaptogale*, *Diacronus*** and ***Stenanagale*** are retained in the family as questionable members.

According to the cladogram, the family Pseudictopidae (or the branch it represented) is possibly the sister group of Anagalidae while Astigalidae secondarily.

图 版 I 说 明

1. 古井曙猬(新属、新种) (*Eosigcle gujingensis* gen. et sp. nov)
V7425, 正型标本 (Holotype), ×1.5
a. 头骨背视 (dorsal view of the skull)
b. 头骨腹视 (ventral view of the skull)
c. 下颌骨冠面视 (crown view of both left and right lower jaws)
d. 右下颌骨舌侧视 (lingual view of right lower jaw)
e. 左下颌骨唇侧视 (labial view of left lower jaw)

2. 余氏棋盘兽(新属、新种) (*Qipcnia yui* gen. et sp. nov.) V7426,
正型标本 (Holotype), ×1.5
a. 上齿列冠面视 (crown view of both left and right upper dentitions)
b. 下齿列冠面视 (crown view of both left and right lower dentitions)


1a
1c
1b
1d
1e
2a
2b